

I CLAIM:

1. In an optical network comprising a plurality of sites, a method of carrying out performance equalization of a plurality of channels, wherein each channel travels through the network from one of the sites, called an "add" site for that channel, to another one of the sites, called a "drop" site for that channel, comprising:

determining a channel-specific figure of merit for each channel;

determining a site-specific figure of merit for each site that is a drop site for at least one channel; and

adjusting a transmit power of each channel as a function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

2. A method as claimed in claim 1, wherein each channel from among the set of channels either dropped at or travelling through any one site occupies a distinct wavelength of light, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel comprises determining a wavelength-specific figure of merit for each channel dropped at the particular site and evaluating a function of each such wavelength-specific figure of merit.

3. A method as claimed in claim 2, wherein said function is an averaging function.

4. A method as claimed in claim 2, wherein said function is the arithmetic mean.

5. A method as claimed in claim 2, further comprising:

determining, for each site that is a drop site for at least one channel, the maximum and minimum wavelength-specific figures of merit;

wherein determining a site-specific figure of merit for each site that is a drop site for at least one channel is performed only if the difference between the maximum and minimum wavelength-specific figures of merit for at least one site that is a drop site for at least one channel is greater than a threshold.

6. A method as claimed in claim 2, wherein adjusting the transmit power of a particular channel comprises:

comparing the channel-specific figure of merit for the particular channel to the site-specific figure of merit for the particular channel's drop site; and

if the channel-specific figure of merit for the particular channel is less than the site-specific figure of merit for the particular channel's drop site, increasing the transmit power of the particular channel;

if the channel-specific figure of merit for the particular channel is greater than the site-specific figure of merit for the particular channel's drop site, decreasing the transmit power of the particular channel

7. A method as claimed in claim 2, wherein increasing or decreasing the transmit power of a channel is performed at that channel's add site.

8. A method as claimed in claim 2, wherein the figure of merit is the "Q".

9. A method as claimed in claim 2, wherein the figure of merit is the bit error ratio (BER).

10. A method as claimed in claim 1, wherein each channel from among the set of channels either dropped at or travelling through any one site occupies a distinct wavelength of light, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel comprises determining a wavelength-specific figure of merit for each channel dropped at or travelling through the particular site and evaluating a function of each such wavelength-specific figure of merit.

11. A method as claimed in claim 10, wherein said function is an averaging function

12. A method as claimed in claim 10, wherein said function is the arithmetic mean

13. A method as claimed in claim 10, further comprising:
determining, for each site that is a drop site for at least one channel, the maximum and minimum wavelength-specific figures of merit;

wherein determining a site-specific figure of merit for each site that is a drop site for at least one channel is performed only if the difference between the maximum and minimum wavelength-specific figures of merit for at least one site that is a drop site for at least one channel is greater than a threshold.

14. A method as claimed in claim 10, wherein adjusting the transmit power of a particular channel comprises:

comparing the channel-specific figure of merit for the particular channel to the site-specific figure of merit for the particular channel's drop site; and

if the channel-specific figure of merit for the particular channel is less than the site-specific figure of

merit for the particular channel's drop site, increasing the power of the particular channel;

if the channel-specific figure of merit for the particular channel is greater than the site-specific figure of merit for the particular channel's drop site, decreasing the power of the particular channel

15. A method as claimed in claim 14, wherein increasing or decreasing the transmit power of a channel is performed at that channel's add site.

16. A method as claimed in claim 10, wherein the figure of merit is the optical signal-to-noise ratio.

17. A method as claimed in claim 1, wherein each channel from among the set of channels either dropped at or travelling through any one site occupies a distinct wavelength of light, wherein determining a channel-specific figure of merit for a particular channel comprises determining a figure of merit for the particular channel at the particular channel's drop site.

18. A method as claimed in claim 17, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel comprises determining a wavelength-specific figure of merit for each channel dropped at the particular site and evaluating a function of each such wavelength-specific figure of merit.

19. A method as claimed in claim 18, further comprising:
determining, for each site that is a drop site for at least one channel, the maximum and minimum wavelength-specific figures of merit;

wherein determining a site-specific figure of merit for each site that is a drop site for at least one channel is performed only if the difference between the maximum and minimum wavelength-specific figures of merit for at least one site that is a drop site for at least one channel is greater than a threshold.

20. A method as claimed in claim 18, wherein adjusting the transmit power of a particular channel comprises:

comparing the channel-specific figure of merit for the particular channel to the site-specific figure of merit for the particular channel's drop site; and

if the channel-specific figure of merit for the particular channel is less than the site-specific figure of merit for the particular channel's drop site, increasing the transmit power of the particular channel;

if the channel-specific figure of merit for the particular channel is greater than the site-specific figure of merit for the particular channel's drop site, decreasing the transmit power of the particular channel

21. A method as claimed in claim 18, wherein increasing or decreasing the transmit power of a channel is performed at that channel's add site.

22. A method as claimed in claim 17, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel comprises determining a wavelength-specific figure of merit for each channel dropped at or travelling through the particular site and evaluating a function of each such wavelength-specific figure of merit.

23. A method as claimed in claim 22, further comprising:

determining, for each site that is a drop site for at least one channel, the maximum and minimum wavelength-specific figures of merit;

wherein determining a site-specific figure of merit for each site that is a drop site for at least one channel is performed only if the difference between the maximum and minimum wavelength-specific figures of merit for at least one site that is a drop site for at least one channel is greater than a threshold.

24. A method as claimed in claim 22, wherein adjusting the transmit power of a particular channel comprises:

comparing the channel-specific figure of merit for the particular channel to the site-specific figure of merit for the particular channel's drop site; and

if the channel-specific figure of merit for the particular channel is less than the site-specific figure of merit for the particular channel's drop site, increasing the transmit power of the particular channel;

if the channel-specific figure of merit for the particular channel is greater than the site-specific figure of merit for the particular channel's drop site, decreasing the transmit power of the particular channel

25. A method as claimed in claim 22, wherein increasing or decreasing the transmit power of a particular channel is performed at the particular channel's add site.

26. A method of generating power adjustments used to control the transmit power of a plurality of channels, wherein each channel travels from a corresponding "add" site to a corresponding "drop" site in a WDM optical network, wherein each channel from among the set of channels either dropped at

or travelling through a site occupies a distinct wavelength of light, the method comprising:

receiving a wavelength-specific figure of merit for each wavelength at each site;

5 determining a channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel;

10 determining a site-specific figure of merit for each site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path; and

15 generating the power adjustment for each channel as a function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

20 27. A method as claimed in claim 26, wherein determining a channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel comprises selecting the wavelength-specific figure of merit for the one wavelength carrying that channel at that channel's drop site.

25 28. A method as claimed in claim 26, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path
30 comprises evaluating a function of the wavelength-specific figures of merit for each channel dropped at the particular site.

29. A method as claimed in claim 26, wherein determining a site-specific figure of merit for a particular site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path comprises evaluating a function of the wavelength-specific figures of merit for each channel dropped at or travelling through the particular site.

30. A method as claimed in claim 26, further comprising:

determining, for each site that is a drop site for at least one channel, the maximum and minimum wavelength-specific figures of merit;

wherein determining a site-specific figure of merit for each site that is a drop site for at least one channel is performed only if the difference between the maximum and minimum wavelength-specific figures of merit for at least one site that is a drop site for at least one channel is greater than a threshold.

31. A method as claimed in claim 26, further comprising:

for each channel, supplying that channel's power adjustment to a variable optical intensity controller at that channel's add site.

32. A method as claimed in claim 26, wherein determining the power adjustment for each channel comprises setting the power adjustment for each channel to the difference between the channel-specific figure of merit for that channel and the site-specific figure of merit for that channel's drop site.

33. A method as claimed in claim 26, wherein determining the power adjustment for each channel comprises setting the power adjustment for each channel to the lesser of a maximum increment and the difference between the channel-specific

figure of merit for that channel and the site-specific figure of merit for that channel's drop site.

34. A method as claimed in claim 26, wherein determining the power adjustment for each channel comprises setting the power adjustment for each channel to a quantized approximation to the difference between the channel-specific figure of merit for that channel and the site-specific figure of merit for that channel's drop site.

35. A method as claimed in claim 26, wherein determining the power adjustment for each channel comprises setting the power adjustment for each channel to a fixed increment times the sign of the difference between the channel-specific figure of merit for that channel and the site-specific figure of merit for that channel's drop site.

36. An equalizer for generating power adjustments used to control the transmit power of a plurality of channels, wherein each channel travels from a corresponding "add" site to a corresponding "drop" site in a WDM optical network, wherein each channel from among the set of channels either dropped at or travelling through a site occupies a distinct wavelength of light, comprising:

means for receiving a wavelength-specific figure of merit for each wavelength at each site;

means for determining a channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel;

means for determining a site-specific figure of merit for each site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path; and

means for generating the power adjustment for each channel as a function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

5

37. Computer-readable media tangibly embodying a program of instructions executable by a computer to perform a method of generating power adjustments used to control the transmit power of a plurality of channels, wherein each channel travels from a corresponding "add" site to a corresponding "drop" site in a WDM optical network, wherein each channel from among the set of channels either dropped at or travelling through a site occupies a distinct wavelength of light, the method comprising:

10
15

receiving a wavelength-specific figure of merit for each wavelength at each site;

20

determining a channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel;

25

determining a site-specific figure of merit for each site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path; and

30

generating the power adjustment for each channel as a function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

35

38. At least one computer programmed to execute a process for generating power adjustments used to control the transmit power of a plurality of channels, wherein each channel travels from a corresponding "add" site to a corresponding "drop" site in a WDM optical network, wherein each channel

from among the set of channels either dropped at or travelling through a site occupies a distinct wavelength of light, the process comprising:

receiving a wavelength-specific figure of merit for each
5 wavelength at each site;

determining a channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel;

10 determining a site-specific figure of merit for each site that is a drop site for at least one channel from the wavelength-specific figures of merit associated with that channel's path; and

generating the power adjustment for each channel as a
15 function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

39. A method of generating power adjustments used to control
20 the transmit power of a plurality of channels, wherein each channel travels from a corresponding "add" site to a corresponding "drop" site in a WDM optical network, wherein each channel from among the set of channels either dropped at or travelling through a site occupies a distinct wavelength
25 of light, the method comprising:

for each site which is a drop site for at least one channel, receiving a channel-specific figure of merit for each channel dropped at that drop site;

determining, for each site that is a drop site for at
30 least one channel, a site-specific figure of merit from the channel-specific figures of merit for all channels dropped at that drop site; and

generating each channel's power adjustment as a function of the channel-specific figure of merit for that channel and

as a function of the site-specific figure of merit for that channel's drop site.

40. An optical system, comprising:

5

a main optical path comprising a plurality of sites for carrying a plurality of channels therealong, each channel travelling from a corresponding one of the sites, known as an "add" site for that channel, to a
10 corresponding other one of the sites, known as a "drop" site for that channel, wherein each site which is a drop site for at least one channel has a capability to determine a wavelength-specific figure of merit for each channel either dropped at or passing through that site, wherein each site which is an add site for at least one
15 channel has a capability to control the transmit power of each channel for which it is an add site; and

15

20

an equalizer connected to each site which is an add site for at least one channel and to each site which is a drop site for at least one channel, said equalizer being adapted to receive a wavelength-specific figure of merit for each wavelength at each site; determine a
25 channel-specific figure of merit for each channel from the wavelength-specific figures of merit for those wavelength/site combinations corresponding to that channel; determine a site-specific figure of merit for each site that is a drop site for at least one channel from the wavelength-specific figures of merit associated
30 with that channel's path; and generate the power adjustment for each channel as a function of the channel-specific figure of merit for that channel and as a function of the site-specific figure of merit for that channel's drop site.

25

30